



Montana Office of Public Instruction
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Mathematics

Beading Patterns Using Reflections

Created by: Linda Engebretson

Grade 10 - Duration 110 minutes

Stage 1 Desired Results

Montana Content Standards: Standard 4 - Applying benchmarks of representing geometric figures on a coordinate grid, exploring properties and transformations of geometric figures and deducing properties of figures using transformations.

Standard 7 - Applying benchmarks of analyzing the effects of changes on the graphs of functions, and relations, including translations.

Essential Understanding 1: There is great diversity among the tribal Nations of Montana in their languages and cultures. Each Nation has a distinct and unique cultural heritage.

Essential Understanding 2: There is great diversity among American Indians as identity is developed, defined and redefined.

Essential Understanding 3: The ideologies of Native traditional beliefs and spirituality persist into modern day life as tribal cultures, traditions and languages.

Understandings:

1. Properties of figures using transformations.
2. An isometry created by a reflection
3. Reflection of coordinates through the x and y axis using the preimage creating the image

Essential Questions:

1. How are the coordinates of the preimage being reflected?
2. How is a reflection created?
3. Why is a reflection an isometry?
4. How are the x and y coordinates changed when reflected through the x axis or the y axis?
5. What is the importance of the line of symmetry to a reflection?

Students will be able to...

1. Identify the x and y coordinates of each point for the shape.
2. Reflect the coordinates through the x axis or the y axis.
3. Identify the pattern when reflecting the coordinates through the x or y axis.
4. Identify an isometry.
5. Identify the coordinates of the preimage and the image.
6. Identify the line of symmetry

Students will know...

1. The quadrants of the Cartesian graphing system
2. How to form a conjecture about the x and y coordinates after reflecting the coordinates through the axis.
3. How to identify the line of symmetry.
4. How to determine the image coordinates after reflecting preimage through the x axis or the y axis

Stage 2 Assessment Evidence

Performance Tasks:

*Use graph paper to plot points and create a design to be reflected.

*Complete reflections, reflecting the preimage creating the image.

*Identify the coordinates of the image using the prime notation.

*Identify an isometry.

*Identify the line of symmetry.

*Develop a conjecture regarding the line of symmetry and the line connecting a preimage point with an image point.



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Stage 3 Learning Plan

Learning Activities:

Before beginning this reflection project, have students observe examples of beadwork. Native American beadwork provides beautiful examples of rotations, translations and reflections. Discuss the history and the cultural importance of beadwork and beads.

"American Indians have been making and using beads for thousands of years. Beads made from precious, semi-precious, and non-precious stones; marine and freshwater shell and pearls; horn; bird, mammal, fish, and occasionally human bone, teeth, and ivory; baked clay; vegetal materials such as seeds, basketry, gum, wood and fruit pits; and gold, silver, and copper were made by members of hundreds of American Indian tribes long before the Columbian encounter. Beads are mentioned in the oral traditions of dozens of tribes in the United States where they are used as ornaments and sometimes in ceremonies. Beads found in thousands of archaeological excavations covering as many years point to the importance and ubiquity of beads in American Indian history and culture" (*Native America in the Twentieth Century: An Encyclopedia*, p. 71).

The above excerpt was taken from *Native America in the Twentieth Century: An Encyclopedia* which was distributed to all Montana public school libraries.

For additional information regarding beadwork see the Smithsonian National Museum of the American Indian Web site titled, *Identity by Design - tradition, change, and celebration in native women's dresses*.

http://www.nmai.si.edu/exhibitions/identity_by_design/IdentityByDesign.html

Before beginning the transformation, examine the picture included with this lesson. The pattern will be used for steps 11-17.

Procedure:

1. Each student needs 3 sheets of graph paper, ruler, and a minimum of four different colored pencils.
2. Draw the x and y axis in the center of the graph paper.
3. Plot the following points and draw the line segment AB. Next, reflect through the x axis by using the definition of reflection: transformation that uses a line that acts like a mirror, with an image reflected through the line.
A(2, 4) B(4, 2)
4. Draw the image (the line A'B') formed by reflecting the points.
5. Discuss the following questions as a class: What is the line of symmetry? (Answer: the x axis) Does the line of symmetry always have to be the x or the y axis? (Answer: no, it could be any line, horizontal, vertical or $y = x$.) Is this an isometry? (Answer: yes, because it preserves length.) (**isometry**: A transformation that preserves length, angle measure, parallel lines, and distance between points)
6. Students should form a conjecture after plotting the points and reflecting the line through the x or y axis. Their conjecture should contain the following:
 - a. if (x,y) is reflected through the x-axis, its image is the point (x, -y)
 - b. if (x,y) is reflected through the y-axis, its image is the point (-x, y)
7. Have students write their conjecture on the graph paper they are using for this first reflection.

8. Discuss with the class: (Have students answer in class)
 - a. What happened to the x coordinate as the point was reflected about the x axis?
 - b. What happened to the y coordinate as the point was reflected about the x axis?
 - c. What happened to the x coordinate as the point was reflected about the y axis?
 - d. What happened to the y coordinate as the point was reflected about the y axis?
9. Have students draw segment AA' , using the preimage point A and the image point A' .
10. Discuss with the class how the line of symmetry and the segment AA' are oriented with each other?
(Answer: Students should recognize that they are perpendicular to each other and that the segment AA' is bisected by the line of symmetry.)
11. Using their second piece of graph paper, have students plot the following points forming a geometric figure, the preimage:

A(0, 0)	B(0, 3)	C(-1, 2)	D(-3, 0)
E(-3, 4)	F(-9, 4)	G(-3, 0)	
12. Connect the following points forming a polygon: AB, BC, CD, ED, EF, FG, GA.
13. Using the conjecture they formed in the discussion from steps 7 and 8, reflect these points about the x axis forming the image. Remember to use the pattern $(x, y) \rightarrow (x, -y)$ if reflecting about the x axis and $(x, y) \rightarrow (-x, y)$ if reflecting about the y axis.
14. Label the image points using the prime notation: A' .
15. Connect the image points as the preimage points were connected above.
16. Next, reflect the preimage points about the y axis forming another image, labeling the new image points with double prime notation: A'' .
17. Reflect the new image through the x axis, labeling the image point with the triple prime notation: A''' .
18. Color the pattern using different colors.
19. Using the third piece of graph paper, try the next reflection and color it in using different colored pencils. Here are the points to form the preimage for the next reflection:
A(0, 2) B(-4, 4) C(-4, 1) D(-7, 1) E(-6, 0) F(-7, -1) G(-4, -1) H(-4, -4) I(0, -2)
Squares inside the polygon: (-1,1) (-3,1) (-3,-1) (-1,-1)
20. Connect the following points: AB, BC, CD, DE, EF, FG, GH, HI and the points for the square inside the polygon.
21. Now reflect these points across the y axis forming the image. Remember the rule for reflection through the y axis: (x, y) then $(-x, y)$.
22. Label the image points using the prime notation A' .
23. Connect the image points which will create an isometry (An isometry preserves length, angle measures, parallel lines and distance).
24. Color the design using different colors.
25. Now create your own design.

At the end of this lesson students will:

- Plot points and identify the x and y coordinates
- Reflect points through the x axis or the y axis and identify the pattern
- Apply the reflection to create the pattern
- Understand the project is an isometry

Teachers resources:

The web address below provides information about the history and cultural value of native women's dresses. The site also provides examples of beautiful beadwork and allows one to see the geometry involved in this art form.

http://www.nmai.si.edu/exhibitions/identity_by_design/IdentityByDesign.html

Materials:

- Graph paper (1 cm squares, 8 ½ x 11)
- Colored pencils
- Rulers

Extension of this project:

- Design or pattern and object to be beaded (watch band, key chain, pen cover, or barrette)
- Seed beads (a variety of colors)
- Thread
- Needles
- Leather (chamois works well)
- Cloth to wrap the object and beads into

